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Heart rate recovery following exercise testing in pediatric patients with acyanotic repaired congenital heart disease

Natalie S. Shwaish
Children's Mercy Hospital, nsshwaish@cmh.edu

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Submitting/Presenting Author (must be a trainee): Natalie S Shwaish, MD
Primary Email Address: nsshwaish@cmh.edu

☐ **Resident/Psychology Intern (≤ 1 month of dedicated research time)**
☐ **Resident/Ph.D/post graduate (> 1 month of dedicated research time)**
☒ **Fellow**

Primary Mentor (one name only): David White, PhD
Other authors/contributors involved in project: Kelli Teson, PhD. Lindsey Malloy-Walton, DO.

IRB Number: STUDY00000611

Describe role of Submitting/Presenting Trainee in this project (limit 150 words):
I performed an extensive literature review to identify gaps in the knowledgebase. Using this information, I formed specific aims, hypothesis, and study design. I wrote the research protocol and submitted the IRB as primary investigator (approved 03/2019). I worked extensively with the data analytics personnel in the Heart Center to collect and build a database. Through the biostatistics department at CMH, I recruited a statistician and reviewed the analysis with him. I wrote the abstract.

Background, Objectives/Goal, Methods/Design, Results, Conclusions limited to 500 words

Background: Attenuated heart rate recovery (HRR) following peak exercise has been shown to be a predictor of mortality in adults with Fontan palliation, coronary artery disease, heart failure, and heart transplantation. Additionally, delayed HRR is a predictor of sudden death in asymptomatic adult males and attenuated HRR 10-seconds after peak exercise predicts mortality in adults without cardiovascular disease. However, there are no large studies evaluating HRR patterns in pediatric patients with surgically repaired acyanotic congenital heart disease (rCHD).

Objectives/Goal: The primary aim is to determine the effects of acyanotic repaired congenital heart disease on exercise stress test HRR pattern in children and adolescents. The secondary aim is to explore the difference in various repaired acyanotic congenital heart disease diagnoses on exercise stress test HRR patterns. We hypothesize that children and adolescents with repaired congenital heart disease will have attenuated HRR following exercise testing when compared to matched controls.

Methods/Design: Data was extracted from the Children's Mercy Heart Center Database for patients 10-18 years old with exercise testing performed in 2007-2017. Two cohorts were compared: 1) rCHD patients, including transposition of the great arteries (TGA), tetralogy of Fallot (TOF), septal defects (ventricular, atrioventricular), coarctation, and pulmonary outflow disease; 2) controls, matched for age, sex, BMI and METs achieved at peak exercise. Peak heart rate (HR) was compared by Wilcoxon rank-sum test. HR values (bpm) were summarized by medians and interquartile range (IQR). Between-cohort differences were evaluated by robust standardized mean difference (rSMD). HRR pattern was analyzed using linear mixed-effects models for the rCHD cohort and for individual lesions.

Results: The study included 336 individuals (rCHD: n=84; controls: n=252), median age 14.6 years, 52.4% male. The two cohorts had similar peak HR (rCHD: 195 bpm [193,196]; control: 196 bpm [193,200]; rSMD=0.027; p=0.077). Between-cohort comparison of HR during recovery and percentage of peak HR during recovery showed no statistical difference. Akaike Information Criterion (AIC) for linear mixed-effects models also suggested no statistically significant cohort-by-time interaction. The rCHD cohort was subdivided: AVSD (1.2%), coarctation/IAA (31%), pulmonary outflow disease (20.2%), TOF (9.5%), TGA (15.5%), VSD (22.6%). There was significant cohort-by-time difference for VSD at minute 2 (p=0.032), pulmonary outflow disease at minute 8 (p=0.039) and TOF at minute 10 (p=0.035). There was a trend of lower peak HR and recovery HRs for TGA patients, and higher HRs for VSD patients. There was greatest intragroup HR variability at minute 1 following exercise.

Conclusions: There were no statistically significant differences in HRR patterns between the control and rCHD groups following exercise. When looking at individual lesions, linear mixed-modelling suggested the TGA cohort had a trend toward lower peak HR and lower HRs during recovery, though not significantly different. Although some lesion specific HR differences were observed in minute 2, 8, and 10 of exercise recovery, these are unlikely clinically significant. To date, this is the largest study of pediatric patients with rCHD to have HRR pattern after exercise stress test evaluated. Future directions will evaluate HRR in individual subgroups, accounting for residual lesions.